## OFFICIAL FIGURES ON UTAH'S METAL OUTPUT

Production in 1899 Shows an Increase of Three and a Half Millions—Output by Counties.

(Special to The Herald.) 1899, made by Assayer in Charge E. B. Braden of the United States assay office here, to the director of the mint, was made public today. It says:

The precious metal mining industry of Utah during 1899 shows largely increased values over preceding years. Below are the figures of this produc-

Quantity. Value. . 169,630,888 \$ 3,506,581.66 Gold, fine ounces .. Silver, fine unces (coining rate) . 7,183,107.21 9,287,249.72 Copper, fine lbs., at 16.67 per cwt. 9,310,344.000 1,552,034.34 at \$4.47 per cwt..87,707,343.000 3,920,518.23 Total .. ..... \$19,266,383.95

Increase in Production. The following table exhibits the increased production of each metal over the output for the preceding year:

Ounces. ....\$5,028,660.22 \$6,501,702.09 In quartz and dry 

Total ...... 7,183,107.21 \$9,287,249.72 The silver originating in lead ores from placers in Utah during 1899. was contained in the shipments of this product to various custom smelters for treatment. These originated principally from the mines of the Tintic region and Park City. Considerable argentiferous lead ore was also secured from the mines at Frisco and at Bingham. The silver won from copper ores was contained in the product from Bingham and Eureka, Outside of the operations of the Chloride Point Consolidated Mining & Milling company at Mercur, the silver values won by the operations of cyanide plants were unimportant and played but a small part in the output of the state. The silver obtained from the dry ores and concentrates is also of sser importance and was contained in shipments from Eureka, Mercur and Frisco. The silver won from the various mills was obtained principally from lead bearing ores treated in the mills at Park City, Eureka, Mammoth and Silver Reef. This was shipped as dore bars for final treatment to the various refineries of the east.

Gold Producing Districts.

The output of gold from Utah riginated in Beaver, Juab, Salt Lake, Jummit and Tooele counties. The products for 1898 and 1899 were as fol-

1134, 1234, 158, 158,

Mining in Utah is thus shown to be in an attractice condition. The above improvement has been characteristic of recent years. The silver-lead feata leading part, and the cyanide process hereafter will have a necessary place in the maintenance of the present output of gold. The year also witnessed the completion and opening of a smelting plant for the treatment of low-

grade copper ores.

Of the foregoing it may be said, geographically, that the Park City and the Tintic are the more distinctly silverlead producing districts; that Mercur is the center of the cyanide treatment f ores and that Bingham is the camp from which the large quantities of grade copper ores are taken. In 1899, nowever, an important amount of copper came from the Tintic district, some in both lead and in dry gold bearing

Gold Output.

The gold that was won from Utah ores in 1898 and 1899 originated among the several divisions of the crude products in the amounts shown by the following comparisons:

824 871 139 042 Inc 212 930, 297, 256, 32, 134, 285588 8 750. 750. 109 109 109 109 108 Va 303, 571 2299 2299 239 Fine Dunces. 14,693,951 10,214,609 27,642,931 11,609,970 10,609,970 10,609,970 109,630,888 24222 2 926 328 328 328 442 60 mi Fine inces. 207,900 053,752 046,736 0,059,930 and ore

22522 The total increase of gold was more

| than 43 per cent over the yield of 1898. Helena, May 13.—The report on the Of this, the amount of gain from quartz production of the mines of Utah during and dry ores was due to a larger extraction from and sale of this product by the mines in the Tintic district. The heavy increase in the value of gold extracted by means of the cyanide process was due to a further perfection during the year of the process and appliances at the Mercur mills. From what has been accomplished, the fuure treatment of a larger tonnage from he extensive ore bodies at this camp is assured. The yield of gold from this source will be maintained and very

ikely further increased hereafter.

The decrease of the gold contained in lead ores was due partly to a lessened value per ton of this metal in the ores themselves, and partly to the manufac-ture of dore bars by the milling and concentration of much of the lower grade lead ore. The gold thus ob-tained from lead ores milled is includ-ed under the head of milling ores. The largely favorable showing of gold de-rived from the copper ores during the year was owing to the Highland Boy smelter having been put into commission in May. This plant was erected to handle the low-grade copper ores from the company's properties at Bingham. The mining of cupriferous ores in the Tintic district was also heavier in 1899 than for some years past. No gold in any appreciable amount was

Origin of Silver.

The amount of silver originating from lead and copper ores, from cyanides and milling plants, and that contained in dry ores and concentrates, during the year 1899, is shown below: GALLEY TWO OFFICIAL FIGURES

Counties. Fine Ounces Beaver 719,73	T 69	Fine Ounces. 1,083,716	1899. Value. 6 \$ 32,738.31	Increase \$ 17,860.11
"fron 290 000 Tutab 38,136, 264 *Salt Larke 9,113,156 Summit 6,429, 041	5,994,83 788,346,55 204,923,71	44,917,386 8,611,860 8,800,797	918,188,86	139,842,33 25,910,71
sified by counties	15	106,214,609	2,195,650.83	1,
Total114,766,891	\$2,372,412.49	169,630,888	\$3,506,581.66	\$1,134,139.48

The increase shown for Juab county is explained by the more active operation of and extraction of ore from several of the largest properties in the Tintic district, notably the Centennial-Eureka, Grand Central and Mammoth mines. The increase from Summit county was due to a larger extraction and reduction of the silver-lead ores from Park City district by the Silver King, Ontario, Daly-West and Anchor mines. The large and important increase of gold taken from Tooele county in 1899 was due to the successful operations at Mercur, where the cy-anide process made rapid advancement in the treatment of the low grades of that camp. It is believed that the present production of gold will be still fur-ther increased in this county and a large output will be maintained for a solve from Salt Lake and Beaver counties shows little or no increase of importance from that of the preceeding year. No gold has been reported as produced

Silver Districts.

The amounts of silver originating in the several counties in 1899, when compared with the corresponding figures for 1888, show the following results:

8 86888513463 18

				*Decrease.
\$792,373.	\$9,287,249.72	7,183,107.21	6,750,255.50 \$8,494,875.79 7,183,107.21 \$9,287,249.72	Total 6,750,255.50
232,307 1,211,269 129,085,317 36,517 187,751	4,305,238.73 260,914.97 4,975,739.49 291,820.72 36,847.01	3,329,833.10 201,801,44 3,152,329,78 225,706,01 28,498,88	4,382,333.00 493,322.13 2,864,479.98 162,735,27 187,751.50	Juab 3.885.67.16 "Salt Liske 3.89.57.16 Summit 2.215.496.24 Toole 1.15,865.56 Washington 1.15,865.56 *Unclassified by countles 1.15,214.05
* 84,101.	Value, 316,688.80	1899. Fine Ounces. 244,939.90\$	Value. \$ 100,789.98	Counties. Ounces. 8Beaver 899,886.00

There is seen to be but little change in the output except in Salt Lake. Summit and Tooele counties. The decrease in Salt Lake county was due to several of the producers of silver at Bingham in the past being comparainto one operation. In Summit county sumption of production by the Daly-West mine and mill, the more extensive extraction and treatment of ores from the Ontario mine, the greater tonnage taken from the Silver King properties during the year. The increase of silver won in Tooele county during 1899 arose from the amounts recovered by cyanide and those included elting ores taken from the mines of the county.

PRODUCTION BY COUNTIES.

Beaver County.

Silver, fine ounces (coining value)..... Copper. fine pounds, at \$16.67 per cwt.... 918,292.000 153,079 28 \$4.47 per cwt......4,983,453.000 222,760 35

\$725,266 75 A large portion of the above output comes from Frisco, where is located the historic Horn Silver mine. This was opened nearly thirty years ago, and has since produced over \$30,000,000 in precious metals, and paid more than \$5,250,000 in dividends. The property has been extensively developed, the lead standing in nearly vertical posi-tion, and is from thirty to 100 feet wide between the walls. The main shaft has been sunk to water level, a distance of 1,600 feet, and the ledge open ed about 5,500 feet on the strike. The character of the ore varies from the surface to the seventh level, lead carbonates carrying silver, gold, copper and zinc being found. At greater depth this becomes more of a coppe and zinc sulphide associated with con siderable galena. It was in the upper workings of the mine that a large tonnage of chloride of silver (horn silver) was obtained, from which fact the mine derived its name. The property is equipped with thirty stamps, sides necessary crushers, rolls, jigs and vanners, to reduce about 150 tons of ore per day to concentrates for shipment. The property is one that seems to have a long period of operations before it for the future, with increased production over that of the last few years. Besides the Horn Silver are a number of mines in process of devel-opment in the vicinity of Frisco, and hould this work all result satisfac-

Juab County.

The values won from ores mined in this county in 1899 were as follows: Total .....

carried on in this county in 1898 is group, by which name the property is nearly \$1,000,000. The activity in min-still locally known, was purchased by ing arises from the districts centered Captain J. R. De Lamar in 1895. This about Eureka, Mammoth, Silver City gentleman, with his characteristic and Diamond. The more important well-directed energy, began immedimines of this county are the Eureka- ate developments on an extensive scale Hill, Humbug-Uncle Sam, Swansea, and in a short time was so well pleased South Swansea, Fortune, Centennial- with his initial purchase that he be-Eureka, Bullion-Beck & Champion, gan acquiring surrounding territory, Grand Central, Mammoth, Gemini, Godiva, Ajax and Showers Consolidated. of 1897, by which time the area of the properties were all at work in group had been increased to over 800 1899 and the output and conditions va-ried slightly from those in 1898. The At that of the Centennial-Eureka, due to from that mine. Nearly operties produce lead in considerable quantities, while at sev-Centennial-Eureka mines. In point of the number of men em-

properties, this district (Tintic) ranks the disastrous effects resulting from first in Utah. The value of the metals even small amounts of this "base" ore, extracted in Juab county is also greater than of any other county in the

Salt Lake County. The value of the precious metal contents taken from the ores produced by the mines of this county in 1899 was

at \$4.47 per cwt....2.334.731.000

rease in value from that of the yield f metals by this county in 1898. The chief district in point of mining activity is at Bingham, where the Highland Boy, Old Jordan & Galena, Old Telegraph, Butterfield, Last Chance, Petro and other mines are located. The naracteristic of many of the ores from this camp is a low percentage of cop-per contained in the ores. Of this product large bodies exist at Bingham and much thought and money have been expended in the past that success-ful methods might be devised for the profitable handling of these ores. As a result of these efforts the High-land Boy smelter has been erected near Salt Lake City to treat the product from the mine of that name at Bingham. The methods therein employed are believed to have successfully solved the problem presented in these number of years. The output of gold ores. This smelter was put into commission in May, 1899, and has since been steadily at work. Incidental to the development of the camp at Bing-ham and the erection of the Highland by either Carbon or Iron counties in Boy smelter was the consolidation of a number of claims at this point into several large companies. The result sought was the more economical handling of these ores and seems to have been accomplished. Besides the Bingham district in Salt Lake county are the camps of the Big Cottonwood, Little Cottonwood and Alta. The produc-tion from these districts in 1898 was

Summit County.

The metals taken from ores mined

Quantity. Value. 8,803.797 \$ 181,990 63 Gold, fine ounces ...

value of the metals output by the mines of this county of more than \$2,000,000, thus showing the increase to have been the greatest of any in the state during 1899. The scene of the most active operations is at Park City. where the large properties of the Ontario, Silver King, Daly, Daly-West and Anchor companies are located. In point of production during 1899 the operations conducted at and the output from the Silver King mine were the most important at Park City, the values, tonnage of ore and number of men employed at this property being greater than at any of the others. The Silver King is also one of the greatest dividend payers at the present time in the state of Utah. The ore reserves in the mine are extensive and the prom ise for the future is very bright. This company in 1898 commenced the erection of a large concentrator plant to handle their lower grade of ore. This was put into commission during the year 1899, with the most satisfactory results, it being one of the most modern and complete plants of its kind in

The Ontario mine, also at Park City, was for many years the leader among Utah mines. The aggregate of dividends paid by this company to date has been nearly \$14,000,000. Of recent years limited operations have been caried on at the Ontario, and the mining of ores on an extensive scale has been suspended. However, during the past year the work was increased, and total values of the metals obtained from their ores show a considerable growth. Another property at Park City that came forward with a largely renewed production was the Daly-West mine. The showing made as a result of the year's operations is most creditable. The control of the mine near the close of the year passed into new hands, being left in the other mines when en-who promise that the output is to be countered, so that it became necessary heavily increased in the immediate fu-ture. The ore reserves in this mine treatment, and to this end laboratory

mined in this county during 1899 were of silver-lead ores, a portion of which 1896, at which time sufficient data had On account of using both inclined and has to be renewed about once a year, 244,939,000 316,688 80 situated near Park City that came into prominence during 1899 as a producer was the Valeo mine. The character of its ores differs from those of the other properties in Summit county. Instead of carrying lead, copper is associated with the gold and silver. The produc-

The quantities and values of the gold and silver taken from the ores mined and treated in this county during 1899 were as follows:

Gold, fine ounces...106,214.609 \$2,195,650 \$3 silver, fine ounces (coining value)....225,705.010 291,820 72 \$2,487,471,55

Golden Gate Mill.

The above values come from the district at and around Mercur, where nearly all the ore mined is treated by the cyanide process. In view of what been accomplished during the has past few years in the working of the enormous bodies of low-grade ores that underlie this camp, the following description and history of Captain De Lamar's mines and Golden Gate mill at Mercur, together with the processes now used, has been written for this report by Mr. D. C. Jacklin. Mr. Jacklin today ranks as the leading expert on the cyanide process in the United States, if not in the world. He was in charge as general superintendent of the De Lamar mines and mills from their purchase by the present owner, torily the output of the county will and it has been to his energy and skill be largely increased hereafter. were evolved and adapted for the profitable treatment of the ores at Mercur. The following is the first time a description has been written by any Gold, fine ounces... Quantity. Value. one connected with this plant, and is especially valuable because of its liver, fine ounces (colning value)... 3,229,833.100 4,305,238 73 authoritative origin. Mr. Jacklin says: The most notable increase in the at \$16.57 per cwt.. 3,441,677.000 573,727 56 gold production of Utah is due to the extensive operations of De Lamar's at \$4.47 per cwt..38,030,904.000 1,702,216 41 Mercur mines, in the Mercur district, which at the present time are pro-over that of the precious metals ex-tracted because of mining operations ing of 143 acres, called the Golden Gate

At the time of De Lamar's first purmost notable increase in output was that of the Centennial-Eureka, due to a more extensive extraction and reduction of or from that mine. Nearly major part of the ores developed in the De Lamar property were of a very different character from those coming eral the amount of copper contained in the ore is quite heavy. This is especially true of the Grand Central and ous causes that the method of coarse crushing and direct cyaniding then in vogue in the mills of the camp was ployed in mining and the tonnage of entirely unsuited for their treatment, ores mined and importance of the as had been clearly demonstrated by other mines, getting into their tank charges and entirely reversing other-

wise satisfactory results. Mercur Ores.

The Mercur ores in general cannot Gold fine ounces... 8,611.360 \$ 178,013 03
Silver, fine ounces
(coining value)... 201,801.440
Copper, fine pounds, at \$16.67 per cwt. 4,145,028.000
Lead, fine pounds.

Gold fine ounces
(coining value)... 201,801.440
Copper, fine pounds, at \$16.67 per cwt. 4,145,028.000
Lead, fine pounds. gold-bearing material, viz., a very fine-grained, minutely fractured and extremely tough hard quartz; a silicious quantities of decomposed porphyry These varieties of rock occur singly and mixed in all proportions. The values in the quartz and limestone lie largely in the numerous frac-ture seams; in the clays and porphyries they are very uniformly disseminated throughout the mass, and this class of ore is usually of higher grade than the others. Locally, the ores are classified into three varieties, according to

their mode of treatment: First, "oxidized ores," consisting of a mixture in which the calcareous and silicious varieties predominate, and in which the proportion of clay and talc is insufficient to interfere with percolation. This class of ore contains only an insignificant quantity of com-pounds of base elements, showing only very small fractional percentages of mercury, as cinnabar, and arsenic ox-

idized compounds.
Second, "talc ores," which are almost entirely clay and talc and soft, decomposed porphyry. These ores, like the class above, are almost free from base element compounds, but impossible of percolation, for the rea-son that on contact with water they disintegrate and settle to an almost impervious mass.

Third, "base ores," consisting of a mixture of the above classes, with the calcareous and talcose varieties predominating and containing large quantities of base metal sulphides. Arsenic is the chief of these, occuring as realgar, erpiment and mispickel, in quantities sometimes as high as 50 The metals taken from ores mined cent, but averaging not to exceed 2 in Summit county during 1899 were as per cent. Realgar is by far the most plentiful of the arsenic bearing minerals, fully three-quarters of the arsenic occuring in this way. Antimony Silver, fine ounces (coining value)... 3,152,329.780 4,075,739 49 coining value)... 3,152,329.780 4,075,739 49 at \$16.67 per cwt... 805,347.000 134,251 34 Lead, fine pounds, at \$4.47 per cwt. 41,884,755.000 1,872,248 55 tals. Mercury is invariably present, \$6,264,230 01 but in less quantities than in the oxidized ores. Various hydrous sulphates The above total is an increase in the of iron are present, as well as oxidization products of arsenic, both simple and in combination, with lime and magnesia. Some of the rarer elements, most notably tellurium, are also present, in traces only. The clays of this class of ore are invariably dark gray or black in color, due to a considerable quantity of carbon, frequently as much as 4 per cent, and in these are sometimes found organic compounds, which decompose potassium cyanide very rapidly. Silver is very sparingly distributed in all classes of ore, rarely ex-ceeding one ounce of silver to ten ounces of gold. No metallic gold is visible in any of the ores until after they have been roasted, when occasional minute irregular particles may be discovered under the microscope. All the clean, base minerals are invariably poorer in gold than the gangue with which they are associated. The clear crystals of realgar and erpiment carry none at all, or only traces, showing that the increased values of the base ore are not directly due to these base metal minerals. The gold in whatever ore found dissolves very rapidly and ompletely in solution of potassium cyanide, indicating that it is very finely divided in whatever condition it occurs and these various facts have led me to ores is present in a finely divided amorphous, metallic state, having the black or brown color characteristic of the metal when in this condition and consequently being unrecognizable under the microscope in its naturally oc-

curring state. Treatment of Base Ores.

Early in the development of the De Lamar properties it was apparent that are stated to be among the largest in experiments were begun immediately

the laboratory work, and in May, 1896, an experimental plant to demonstrate these results on a larger scale was completed. This plant, capable of treating five tons of ore at a time, was completed with complete cruising rogst. equipped with complete crushing, roasting, leaching and precipitating mawith the gold and silver. The production from Park City last year now makes Summit county the second in importance in the state and a close rival for first place.

County having served its purpose in demon strating that the refractory ores of the Mercur district could be successfully treated by the methods hereinafter described, and almost immediately af-

Golden Gate Mill. The mill is built in eight levels on the hillside above the mines, having a slope of 20 degrees. It has been en-larged twice since the completion of the original design in March, 1896, and described as it is at present. will be described as it is at present. The highest level is occupied by a steel ore bin, having a capacity of 2,500 tons, on top of which is erected a steel gallows frame, carrying the hoisting cables from the mine to the power house. Above the ore bins is also located the coarse crushing machinery, consisting of two No. 6, style D. Gates crushers. Into these the ore D, Gates crushers. Into these the ore is dumped over grizzlies direct from the skips, and passing through the crushers, falls into the storage bin beow. The ore is delivered to the milly three-ton skips, running in balance direct from the mine through 300 feet of vertical and 400 feet of inclined shaft, and then over 200 feet of in-clined steel bridging connecting the mouth of the incline from the mine with the top of the gallows frame. The hoisting is done by a double drum elec-tric hoist, situated 100 feet up the hill

back of the gallows frame and main The next section below contains the ecessary drying machinery, consisting of two straight-line driers with hearths sixty feet long by twelve wide, and two revolving cylindrical driers, seven feet in diameter at the discharge end and thirty feet long. The third level contains the fine crushing machinery, screens and elevators required to fin-ish the crushing of the ore to the necessary fineness, and deliver it to the steelfinished ore storage bin of 3,000 tons capacity, also located on this level. The achinery of this section consists of four sets of 15x36 and five sets of 15x26 Gates high-grade rolls; 9.24x8 Berthe-lot separating screens; 4.48x8 revolv-ing hexagonal screens; 6.12 elevators and two motors, one of 150 horse power and one of 100 horse power, giving the necessary power for driving the mahinery of this and the drying sec-

The next section, embracing three levels, contains the roasting and calcining machinery, consisting of nine straight line furnaces, each with a roasting hearth 100 feet long and twelve feet wide. Three of these are of the Jacklin pattern, two are Holtoff-Wethey, and the four others were originally built according to the Brown designs, but have been entirely reconstructed and made to correspond with the Jacklin pattern as far as possible, being supplied with Jacklin mechanical parts throughout.

The next section contains the leaching tanks, twenty-six in number, each twenty-five feet wide, fifty feet long and five feet deep, and having a capacity of 260 tons. Adjacent to and above this lovel and the selection of the deep the selection of the selection o this level are three solution standardizing tanks, having a combined capacity of 500 tons of solution. The next and last section contains three precipitating tanks, having a combined capacity of 100 tons of solution; two gold solution tanks, holding 300 tons, and one barren solution sump tank holding 150 tons; nine Stilwell-Biorce & Smith-Vaile all ison filter presses distance of the second state frame pattern, each having thirty-six sections, twenty-four feet square; 2,600 of roasted ore in twenty-four hours, gallon, cycloidal, belt-driven pumps, and a ten H. P. belt-driven air com-

pressor.

Electrical Power. electrical power, derived from the Provo river, thirty-seven miles distant. named capacity, which is obtained by The current is transmitted by the threephase system, over three No. 5 bare opper wires, at a pressure of 40,000 thicker bed of ore, usually about six volts, to the sub-station near the upper part of the mill, where it is transform-ed to a tension of 220 volts, for use by Westinghouse type C. two-phase, in-Westinghouse type C, two-phase, in-duction motors and distributed for dull red heat, pass through in six hours. power and light purposes for the mill and mine at this pressure. There are in use for every purpose twenty motors, ranging in size from ten to 150 H. and greater capacity, and are used for P., and giving for all uses the utmost that purpose. The other furnaces, satisfaction, and requiring a surpris-ingly small amount of attention and repair. In stormy weather there has been considerable difficulty and delay occasioned by the breaking down of the furnaces whether run as calciners the long distance transmission system, and to overcome these delays in the future an 800 H: P. steam generating plant at the mill is just being completed. The plant is equippped with complete and commodious shops, in which all the repairing and manufacturing work required about the place. It is furnaces whether run as calciners or roasters, viz: Six and one-half tons of slack coal per day. All the furnaces are run with a light forced draft, Sturtevant blowers being used for that purpose. After being roasted or calcined as the case may be, the heated ore is elevated at the discharge end of the furnaces whether run as calciners or roasters, viz: Six and one-half tons of slack coal per day. All the furnaces are run with a light forced draft, Sturtevant blowers being used for that purpose. After being roasted or calciners of slack coal per day. All the furnaces are run with a light forced draft, Sturtevant blowers being used for that purpose. After being roasted or calciners of slack coal per day. All the furnaces whether run as calciners or roasters, viz: Six and one-half tons of slack coal per day. All the furnaces are run with a light forced draft, Sturtevant blowers being used for that purpose. After being roasted or calcined as the case may be, the heated or is elevated at the discharge end of the furnaces whether run as calciners or roasters, viz: Six and one-half tons of slack coal per day. All the furnaces whether run as calciners or roasters, viz: Six and one-half tons of slack coal per day. All the furnaces are run with a light forced draft, Sturtevant blowers being used for that purpose. After being roasted or calcined as the case may be, the heated or slack coal per day. which all the repairing and manufac-turing work required about the place is done, with the exception of making castings, which are purchased in the anism to its return motion to the feed

The extreme length of the mill through the leaching department, the longest section, is 720 feet along the face of the hill, with a width up the hill of 500 feet, measured on the nat-ural slope. The immensity of the plant can be better understood from the fact that the single floor space covered by the main and adjunct building is something over three acres. The total surface area necessary for the accommodation of the entire plant is nearly ten acres. The buildings are steel throughout, with the exception of the power house and refinery, which are brick, with corrugated iron res. The tanks and ore bins are also of steel, there being no wood anywhere in the plant except where it was desirable to use heavy timbers rather than steel or machine foundations.

The ores are roughly graded in the mine into the three classes above described, viz: "Oxidized," "talcy," or, as it is called at the works, "mixed," and 'base," and these classes are kept separate until the furnaces are passed, when they are all mixed together, to go to the leaching tanks.

Crushing Arrangement. In order to keep the three classes of

through the small rolls, which are kept set fact to face. From the small rolls the ore passes to elevators, and is elevated to revolving screens over the finished ore bin. From these screens, the fines drop directly into the bin, and the rejections are returned to the small rolls for further reduction. It is selthe larger portion of the ores were of the base or talcose varieties above as the ore as it comes from the mine, described, and which were at that time except at unusually wet seasons, can

is treated by milling and concentrating at Park City, the balance being shipped to the smelters for reduction. Besides the mines noted, a property idized ores so that they will pass a account of its having collected enough 3-mesh No. 16 wire cloth; the talcose fine climes to become hard and slow of or mixed to pass a 4-mesh No. 16 wire, and the base an 8-mesh No. 16 wire. About 90 per cent of the pulp will pass these sizes, the remaining 10 per cent of eligibitis. of slightly coarser material having charge for applying the first solution, gone through the inclined screens, the and as this labor is paid \$2.50 for eight

> from it by means of an elevator dis-charging into a small hopper connected by a 6-inch standard pipe to each of the furnace automatic feeding hoppers. It is worthy of mention that all spouts in the mill are finely as a second standard spouts. in the mill are 6-inch or 8-inch standard black pipe, and that they serve the purpose admirably from the fact that they are dustless, seldom clog, and when worn on one side can be turned when worn on one side can be turned one-third way over, thus affording three new wearing surfaces for one spout, and avoiding the troublesome operation of frequent repairing. The other five furnaces are automatically again run on the top. This is continued for twenty-four hours and is followed by a weaker solution, of strength three-

Process of Roasting.

of arsenic, have these constituents to duced to about % of 1 per cent and 1-10 begins charging till it is again ready to be filled six or seven days. All solutions, whether strong, weak or wash, tions, whether strong, weak or wash, calcium sulphate, the sulphur remaining as sulphides rarely exceeding 1-10 of 1 per cent, and usually being lower. The arsenic sulphides, realgar and or piment, begin to volatilize with only partial decomposition, causing dense orange colored vapors to arise, before the ore reaches the first fireboxes in its travel through the furnace, and by the time it reaches a dull red heat, 90 per cent of these minerals have been discharged, but the most difficult part of the roasting operation follows in completely oxidizing the pyrites and arseno-pyrites. This difficulty is partially due to the fact that a high heat is not permissible on account of the presence of from 5 per cent to 10 per cent of lime in the ore, producing a mixture which sinters easily and is consequently ruined. It is worthy of note that in most careful investiga-tions and checking of results on the roasting of over 100,000 tons of this arsenical ore. no appreciable gold losses could be detected that were traceable to other causes than ordinary dust losses, which were only a small fraction of a per cent. The talcose ores are calcined, not so much for the purpose of ridding them of any deleterious compounds, as to change their physical characteristics, although the small amount of arsenic present in them, as arsenous acid and its compounds, is slightly reduced. The sulphur contents, all of which are present as sulphates of the alkaline earths, is not affected. The primary reason for the calcination of this ore is to dehydrate the clay and talc and deprive them of their proper-ties of placticity, thus rendering them amenable to percolation, and this is very effectively done. The effect on the clavev ore is much the same as that of burning a brick clay, and the particles of ore which when raw would immediately disintegrate on contact with water are after calcination unaffected by it. The ore is at the same

In roasting base ore, the furnaces are driven at about forty feet per min-The plant throughout is driven by lectrical power, derived from the they have about double the above speeding them up slightly and increasthe same amount of fuel is required for end of the furnace. During the six or eight hours required for its return trip it has become cooled, and is sprayed with water until slightly moist, for the double purpose of giving a more porous charge in the leaching tanks and avoiding dust in handling it to them. Just before reaching the feed end of the furnace again, the now roasted and cooled ore is discharged off the side of the furnace and automatically fed to the mixing and charging bin, from which it is drawn into cars for thargsible.

ore separate, the crushing machinery is necessarily arranged in three series, and both the large storage bins divided into three compartments. The level of the top of leaching tanks and then removed, and the suspended ided into three compartments. The

burlap is tucked, and over this a sec-ond covering of sixteen-ounce burlap. except at unusually wet seasons, can Iron strips are then fastened over the be rolled and screened to the proper covering by nailing them through to fineness without previous drying. On each longitudinal strip of the frame, filtering operation is continuous, as this account, belt conveyors have been These strips are to protect the cloth in while one tank is filling another is disprovided above the driers to convey shoveling out tailings. This filter is charging and the third settling, and by ore from the coarse ore bin to the rolls very effectual, giving a perfectly clear this system as much as 2,500 tons of The precious metal contents of ore All of the above mines are producers 1895, and countinued into the spring of These also work entirely automatically.

gone through the inclined screens, the mesh of which is necessarily coarser than the product desired, on account of the inclined position of the cloth.

From the finished ore bin, the oxidized ore is ready to go direct to the leaching tanks, the base and mixed classes going to the roasting and calcining furnaces. The four furnaces nearest the bins are automatically fed from it by means of an elevator disappoint of the charge under a fourteenfoot head from the standardizing tanks and as this labor is paid \$2.50 for eight hours' work, it will be seen that the course is charged into the vats for less than  $2\frac{1}{2}$  cents per ton. All tanks are connected bottom and at top only to weak solution and water mains. The first solution is applied to the ore from the bottom of the charge under a fourteenfoot head from the standardizing tanks. above. This solution contains four-tenths to five-tenths of one per cent potassium cyanide, or eight to ten pounds of the solid salt per ton of solution, and is allowed to saturate charge slowly until solution begins to appear at the surface, which requires about eight hours, when it is shut off at the bottom, and sufficient additional solution run on top to cover the charge about two inches. Thus it is allowed to stand for about sixteen hours, when other five furnaces are automatically fed by two belt conveyors, one conveyor supplying two furnaces, and the other, which is over 200 feet long suportion of the other three.

The other five furnaces are automatically for twenty-four hours and is followed by a weaker solution, of strength three-tenths to thirty-five-one-hundredths of one per cent, for from forty-eight to seventy-two hours, or until preliminary samples, which are taken every day, The base ores are roasted to a "dead" or "sweat" condition, or as nearly so as practicable, being finished at a bright red heat. The raw ores, entering the furnace with about 2 to 5 per cent sulphur and 1 to 2½ per cent sulphur and 1 to 2½ per cent description. coming from the leaching tanks run into a common launder direct to the gold solution storage tanks. tion is continued without interruption when once started. When a strong so-lution of forty-five-one-hundredths of one per cent is being used, these mixed solutions coming from the various leaching tanks, have a strength of thirty-three-one-hundredths to thirtyfive-one-hundredths of one per cent and this solution, after being precipitated, is pumped back and used as weak solution without the addition of any fresh cyanide. The leaching rate varies greatly with the character of the ore in the charge, being most rapid with charges containing a large proportion of the coarsely crushed oxidized and calcined mixed ores. The practice is to allow three-fourths of an inch to one inch depth of solution in the leaching tank to pass off each hour, but with charges containing a large proportion of base ore, this ratio is frequently not attainable, sometimes dropping as low as one-half to one-third inch per hour, thus requiring that the charge be given longer time in order to get the necessary amount of solution through it, or that vacuum pumps be used, which is now sometimes done, although the standard practice is to leach by gravity The best results are attained when the total solutions and wash passing through the charge is about two tons of solution to one ton of ore.

A peculiar condition sometimes arises in tanks containing large proportions of roasted base ore, or all of this class, from the fact that the proportion of calcareous clays and silicious limc-stones are right to make a pretty good cementing material when burned, and in such cases the charge sets and becomes very hard after about two days' contact with solution, rendering preliminary sampling with an auge difficult and greatly impeding percolation. When the percentage of limestone is exceptionally high in the ore, and is pretty thoroughly burned to lime in the furnaces, its subsequent hydration on contact with the solution will even cause a tank charge of ore, all of this class, to swell perceptibly, and in such cases leaching becomes extremely slow been used as roasters and as calciners. and difficult. The consumption of cyan they have a capacity of seventy tons ide in leaching is about nine-tenths a pound per ton of ore, one-half of first strong solution applied, and a considerable portion of the remainder lost by imperfectly washing out the weak solutions. The actual consumption from the weak solution during its

> able. Cyanide Solution.

The standard strong solution is made by adding the necessary cyanide in lumps to the weak solution formerly, described. Before bringing ide strength up to st to standard, however, a sufficient quantity of caustic soda is added to bring the solution to a fixed standard alkalinity, about a pound of caustic soda per ton of solution being used for this purpose. By this means a very great saving of cyanide is affected, amounting, as found by practice, to about one pound of cyanide saved for every pound of caustic soda used. On account of absence of sufficient water to flush tailings out of tanks, these are discharged by shoveling through gates in the bottom into cars below holding two and one-half tons, and trammed out of the building by men. Each tank is provided with eight dis-charge gates, fifteen inches in diameter, located above four longitudinal tracks running the full length of the building below the tanks. Discharging a tank takes five to seven hours, and costs 6 to 8 cents per ton, depending on the condition of the charge of tailings, i. e., whether they are more or less compact.

Zinc Precipitation. Precipitation of the gold from the so-

lution is effected by means of zinc dust. The material used is the blue powder by-product obtained in zinc smelting. The dust used by the company is imported from England or Germany, and contains about 90 per cent metallic which it is drawn into cars for charge contains about 30 per cent metallic ing the leaching tanks. Four of the zinc. The solution is pumped from the furnaces are in such a position that gold solution tanks to the precipitation tanks, of which there are three, Thirty or pit, which is excavated in the middle furnace level, the ore being brought | tation in each tank. While the tank is dle furnace level, the ore being brought to it from the other furnaces by a system of belt conveyers. Into this pit is also drawn the oxidized ore from the finished ore bin, and it is essential that care be taken to get the most intimate mixture of all classes of ore before charging into the tanks, as otherwise greatly verying leaching rates will take the charge amount of unconsumed. greatly varying leaching rates will maintain, through the different character of ore, crushed to different degrees of fineness in the same charge, amount being seived in, beginning when and uniform leaching results be impos- the tank is half full, and continuing the additions at intervals until the tank is Leaching Tanks.

The bottom of the charging pit is bottom of the tank for a short time, to and then removed, and the suspended crushers are so arranged that two classes of ore can be taken through either of them. but the rolls are operated each series for one class only. The crushers are set so that everything passing through them will pass a two passing through the coarsely crushed.

The coarsely crushed that two classes of ore can be taken through ing the mine, the ore is handled manually side of the tank eight inches above the bottom, and as it still contains considerable quantities of suspended gold slimes, it is passed through the filter presses to collect these, and runs from the manually over the tops of them for the full length of the section. matter allowed to settle about half an fed to the driers and by them discharged to the heads of Berthelot screens, the firest going direct to the elevators, which discharge them into their proper finished ore-bins comthem to their proper finished ore-bins companies.

The filters in the leaching tanks are sump. It is pressure to force the solution through the pressure to force the pressure to force the solution through the pressure to force the pressure to of large rolls, set with their faces about a half inch apart, to another inclined screen, where the fines are again removed, the rejections passing on through the small rolls, which are kept. with two inches of gravel sized to about tanks, and connected with them by three-fourths inch, one inch of gravel large pipes, so that a tank of solution sized to about one-half inch, and one can be discharged into them in a very inch of coarse sand. Between each of few minutes, and thence forced through these layers of filling is laid a strip of twelve-ounce burlap, fitting the compartment neatly. On top of the finished gravel bed, a covering of twelve-ounce burlap is tucked, and over this a second covering of sixteen ounce burlap is fucked, and over this a second covering of sixteen ounce burlap is tucked. layers of light canton flannel, between which is placed a sheet of heavy unsized paper. The precipitating filtering operation is continuous,

(Continued on Page 19.)